

Site Built Fenestration Products

1. Site Built fenestration products (Curtain Walls, Window Walls and Sloped Glazing)

A few things to be aware of:

- Review the drawings carefully for non-continuous elements. These systems tend to have many such elements including shear blocks, installation clips and spacers at the bolts.
- Site built modeling is partially dependent on the installation of the product. Make sure that the drawings you have show the installation.
- Site built products are typically multiple lite systems where the intermediate vertical and horizontal frame members repeat in some pattern.
- Curtain Walls, per NFRC 100 Table 4-3, shall be simulated and tested with the intermediate verticals as jambs and intermediate horizontals as the head and sill members.
- Window Walls, or also known as strip windows, per NFRC 100 Table 4-3, shall be tested and simulated with intermediate verticals as jambs and standard head and sill members.
- Sloped Glazing may also be rated based on the centerline dimensions if utilized like a curtain wall or window wall, except for solariums and sunrooms. Sloped glazing of solariums and sunrooms shall be simulated and tested with standard jamb, head, and sill members.

Modeling of the representative products above used to compare to the physical validation test is as follows:

1. Simulate the full vertical intermediate member twice (for the left and right jambs):
 - a. Once with the left glass replaced with wood, which is the same thickness as the IG unit
 - b. Once with the right glass replaced with wood, which is the same thickness as the IG unit. The wood shall extend to the original sightline.
2. Simulate the horizontal members.
 - a. If this is for a curtain wall, then once with the top glass replaced with wood, which is the same thickness as the IG unit and then a second time with the bottom glass replaced with wood, which is the same thickness as the IG unit. The wood shall extend to the original sightline.
 - b. If this is for a window wall or sloped glazing, then the standard sill and head members are modeled.
3. A physical thermal testing laboratory shall test a sample with the same cross sections as simulated in the steps listed above per NFRC 102.
4. Validation is checked by comparing the values obtained by simulating the product using steps 1 and 2 above, and the physical test results.

1.1. Curtain Walls, Window Walls, and Sloped Glazing

NFRC defines a curtain wall and window wall as any building wall carrying no super imposed vertical load. A *curtain/window wall system* will typically be exterior to the building framework and will typically bypass the building floors.

NFRC 100 Table 4.3 states that curtain walls, window walls, and sloped glazed wall systems are simulated as two lites with one vertical mullion. See the introduction to this section for the specific members of curtain walls, window walls, and sloped glazed wall systems that are to be modeled. If the intermediate vertical and horizontal members were simulated full width or height for the jambs, head and sill, then the total area of the frame as simulated would be significantly larger than actual frames, so for rating purposes, some members (depending on whether it is a curtain wall, window wall or sloped glazing) are simulated as 1/2 the full height (for head and sill) or width (for jambs). The vertical mullion is always simulated full width.

Modeling Procedures:

- **Curtain Walls:** See the modeling steps in the following section.

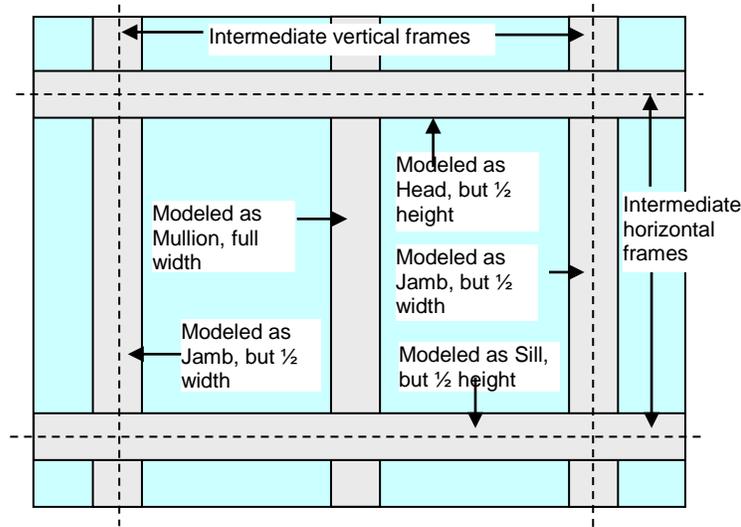
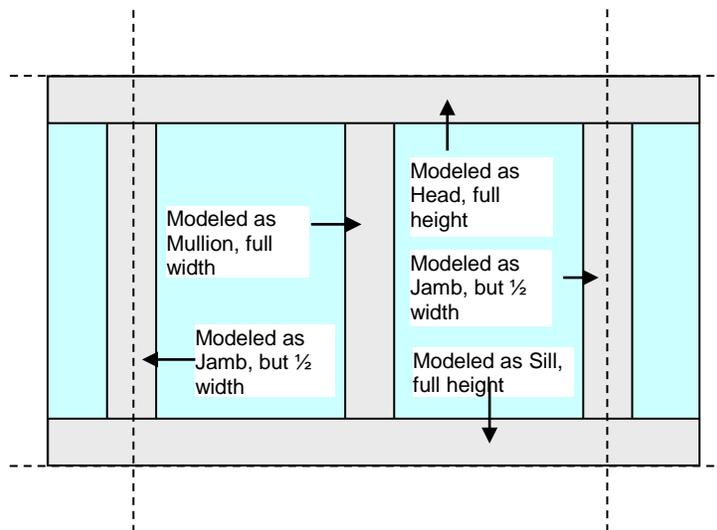


Figure 1-1. Curtain Wall Modeling Method

- **Window Walls:** For window walls, the standard head and sill members are modeled, and therefore the



steps for simulation are identical to that of a normal window cross-section.

Figure 1-2. Window Wall Modeling Method

- **Sloped Glazed Wall System:** If the product to be simulated is a sloped glazed wall system, then the modeling steps are identical to a curtain wall or window wall, except that the cross-section is to be sloped 20 degrees (see skylight section for instruction on sloping products).

1.2. Curtain Wall Modeling Procedure

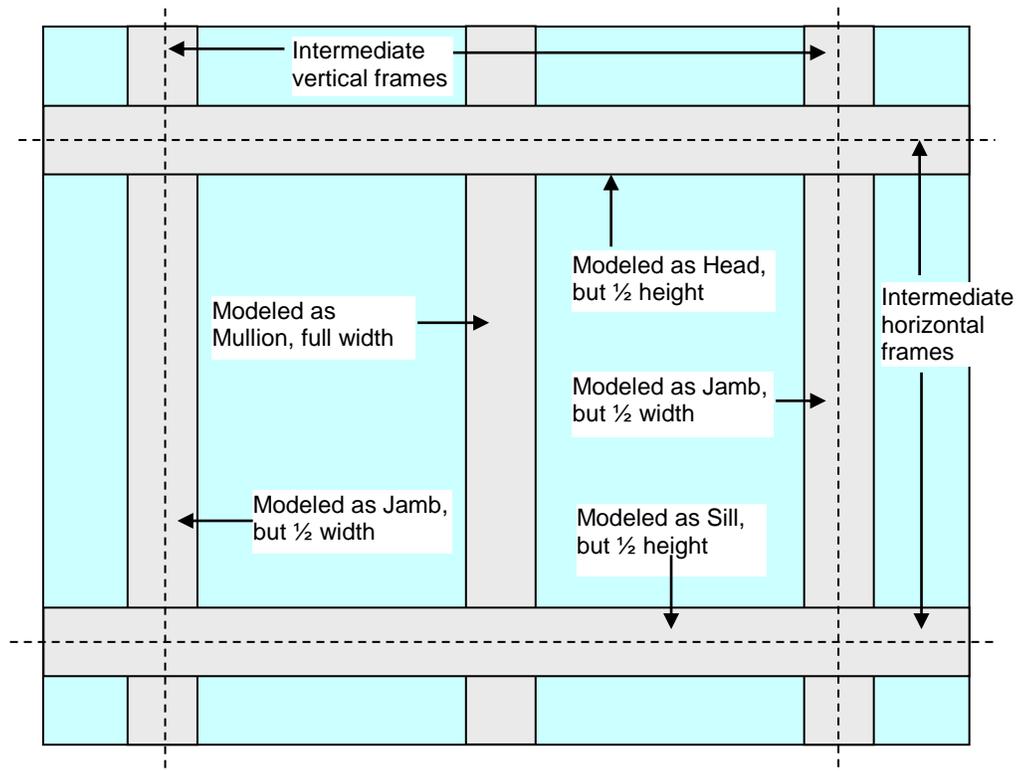


Figure 1-3. Curtain wall simulation model (represented by dotted lines) for rating, where the framing members are modeled at half their width.

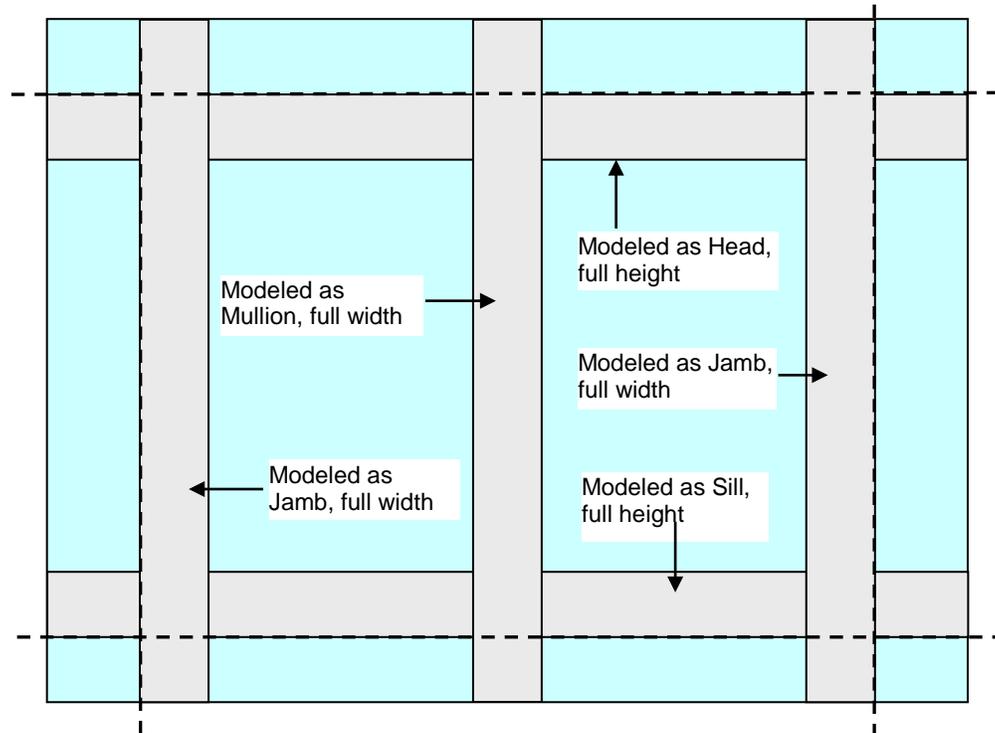


Figure 1-4. Curtain wall simulation model (represented by dotted lines) to match *testing*.

Steps in Modeling Curtain Walls for Rating Simulation

In WINDOW:

- Create glazing systems in WINDOW as usual, with Tilt set to "90".

In THERM:

- Draw the cross sections for curtain walls in the same manner as any other model in THERM – it will be a model similar to a meeting rail.

The following discussion lists the steps for making cross sections for intermediate horizontal and vertical frames. In the example, the horizontal frame and vertical frame are the same so only one drawing will be needed.

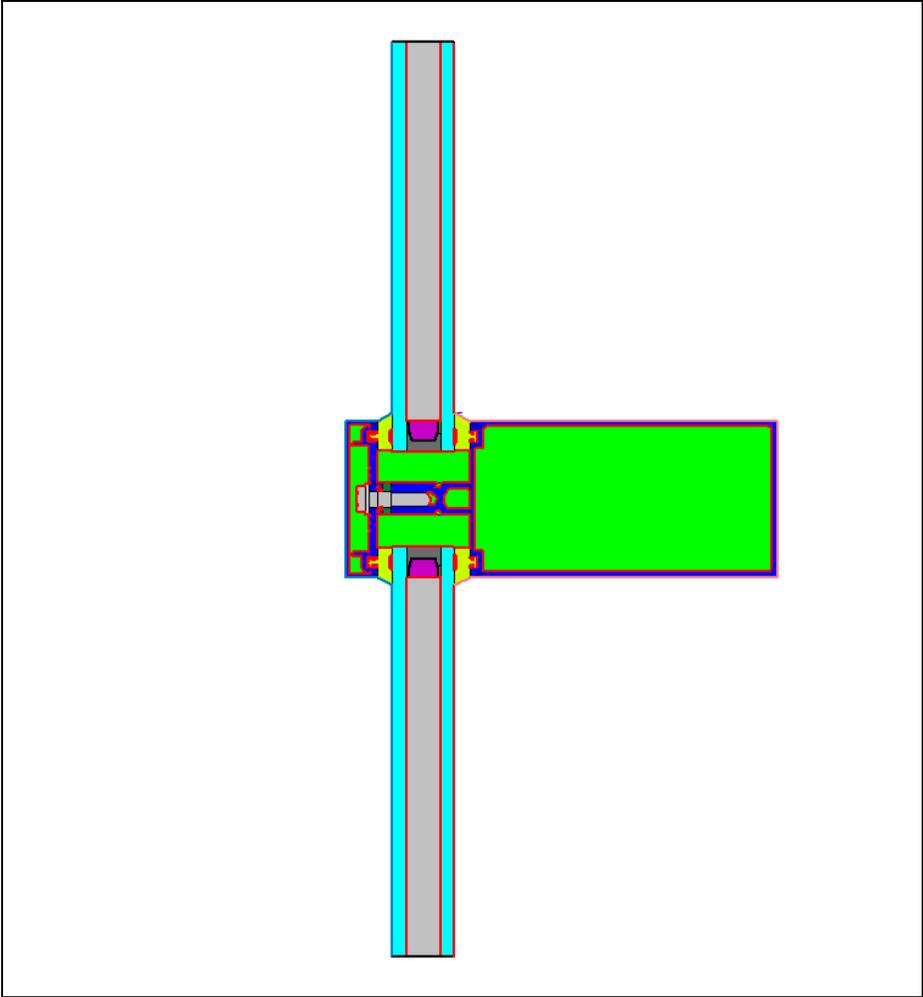


Figure 1-5. Curtain Wall Mullion Cross Section

Modeling the Intermediate Vertical Mullion:

Using the dimensioned drawings or a DXF file, create the cross section for the frame portion of the vertical mullion. The figure below shows a THERM cross section of the frame portion of the vertical mullion.

Make sure that the section is oriented correctly with the glazing oriented up and down.

- If bolts are present make sure to model them as non-continuous thermal bridging elements if needed.
- Pay particular attention to the aluminum finish in order to assign the correct materials to the drawing. (In the figure below, where the arrows point to Aluminum)

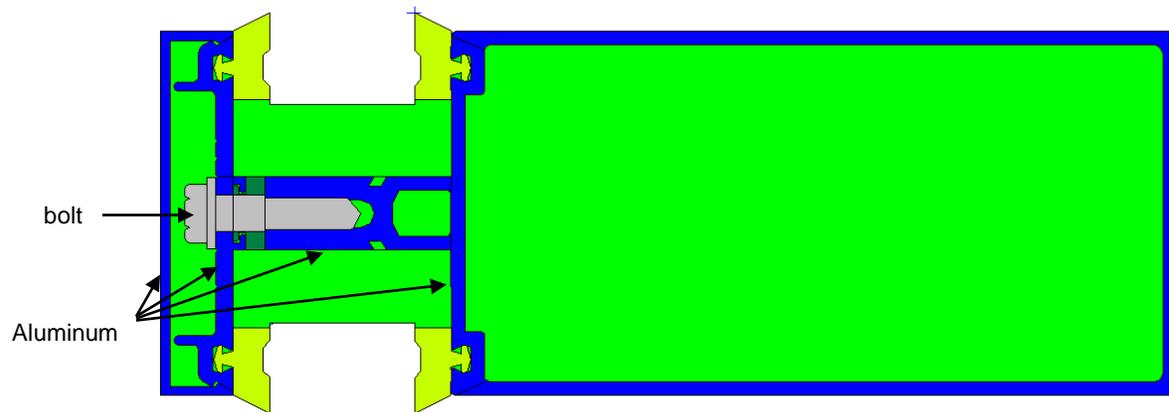


Figure 1-6. Mullion frame cross section without glass

This vertical cross section will be used for the vertical intermediate (mullion) and for the jambs. The jamb model it is necessary to determine and mark the $\frac{1}{2}$ width point between the sightlines. The easiest way to do this is to make temporary reference rectangles as follows:

Determine Frame Midpoints

In order to model the “half-width” frame dimensions for the rating simulation, it is necessary to determine the mid-point of the frame, which is most easily done before the glazing systems are inserted.

- Draw a rectangle from the sightline (highest interior point) for both glazing systems, going horizontally in both directions, so that each rectangle is larger than the horizontal dimension of the frame.
- On both the right and left side of the frame draw a rectangle between the other two reference rectangles and make sure it contacts the frame.
- Measure the exterior rectangle just created in the vertical dimension. The midpoint of the frame is half of this dimension.
- For both the right and left sides of the frame cross section, select the vertical frame component and insert a point on the frame at the midpoint dimension.

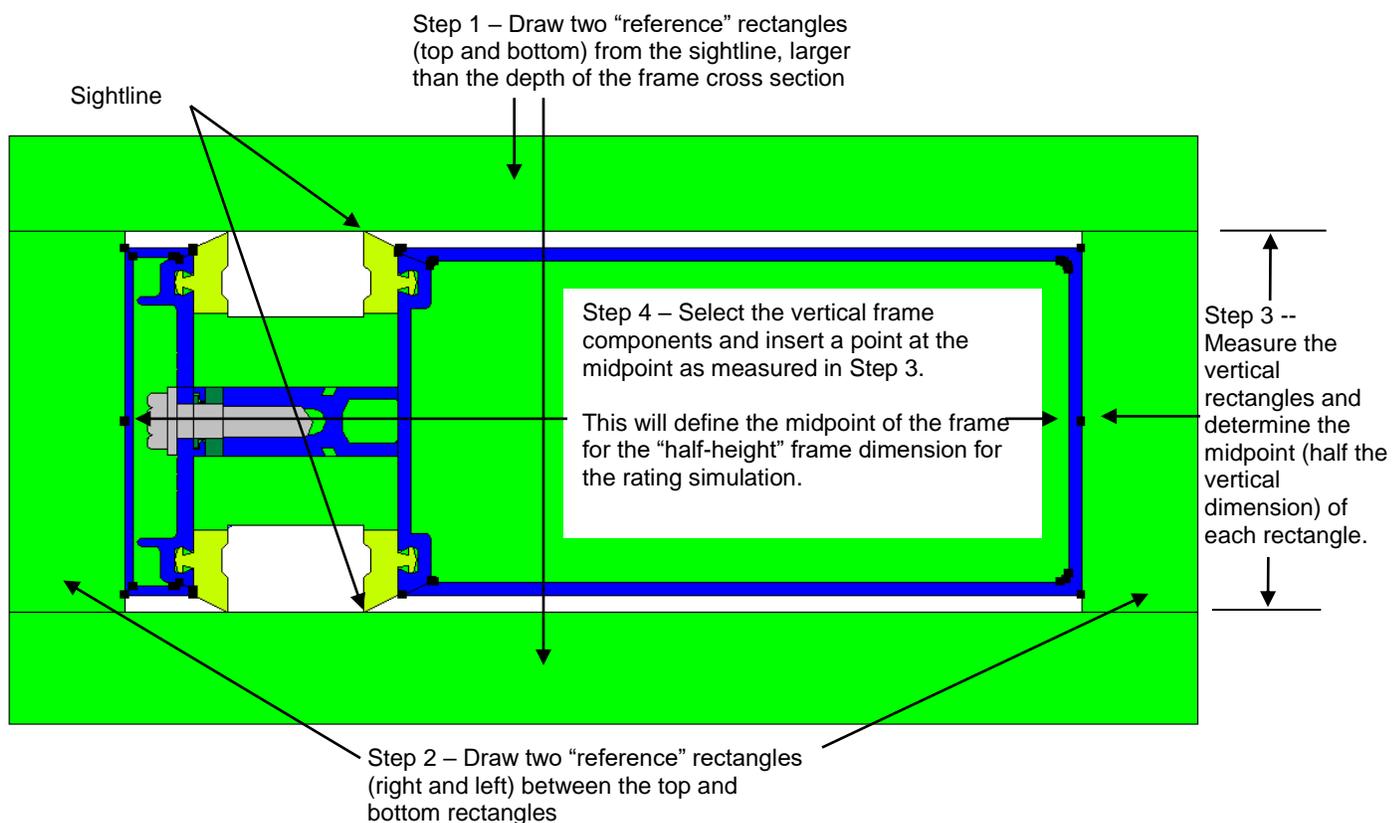


Figure 1-7. Determine the frame mid-points

Finish the cross section

- Delete the four “reference” rectangles.
- Insert the glazing and spacers as usual.
- In **Therm File Properties** (File/Properties), set the **Cross Section Type** to “Vertical Meeting Rail”.
- Assign the **Boundary Conditions** as follows:
 - **Interior Frame:** For the mullion cross section, the entire frame width (not just half) is modeled, so all the interior frame boundary condition elements are assigned a **Boundary Condition** of “<frame type> Interior (Convection Only)”, and a **U-factor Surface** tag of “Frame”.

- **Interior Glazing:** Set the **Boundary Conditions** for each glazing system to “<glazing system> U-factor Inside Film” and the **U-factor Surface** tag to “Edge” for the first 63.5 mm (2.5 inches) from the sightline, and “None” for the remainder of the glazing system.
- **Exterior Frame:** Set the **BoundaryCondition** to “NFRC 100-2010 Exterior” and the **U-factor Surface** tag to “SHGC Exterior” for the exterior frame
- **Exterior Glazing:** Set the **BoundaryCondition** to “NFRC 100-2010 Exterior” and the **U-factor Surface** tag to “None” for both exterior glazing systems.

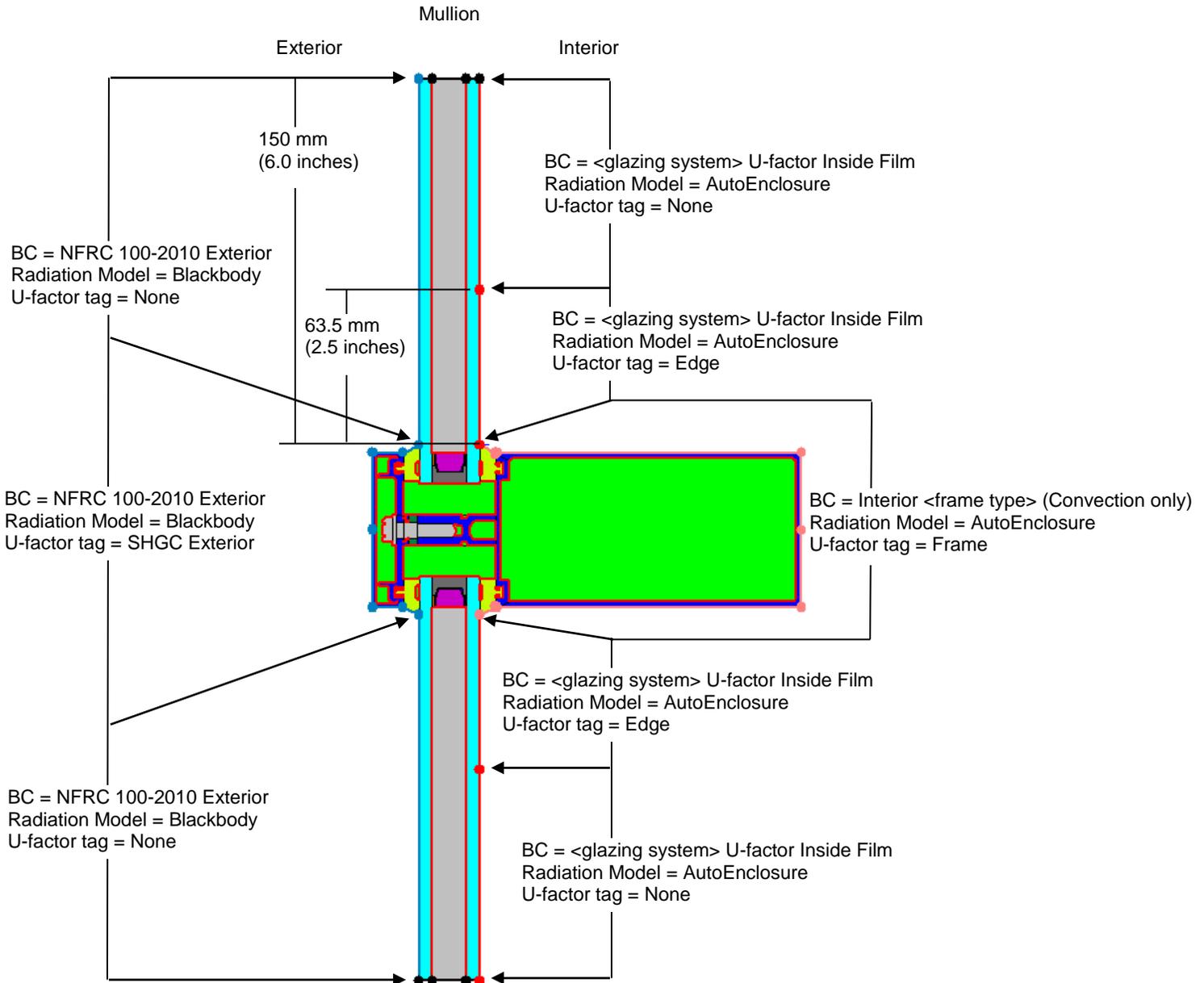


Figure 1-8. Curtain Wall Mullion Boundary Conditions

Modeling Curtain Wall Jambs:

In this example, the curtain wall jambs are modeled using the same drawing as the mullion. The boundary conditions are adjusted to capture the heat flow of only half the width. Since the sections may be asymmetrical, both the left and right portions of the mullion are required to be simulated as left and right jambs.

For the Right Jamb:

- Copy the vertical mullion drawing with boundary conditions assigned.
- In **Therm File Properties** (File/Properties), set the **Cross Section Type** to “Vertical Meeting Rail”.
- Do not change the **Boundary Conditions** but assign new **U-factor Surface** tags as follows:
 - **Interior Frame:**
 - from the midpoint to the top sightline set the **U-factor Surface** tag to “Frame”
 - from the midpoint to the bottom sightline and the entire bottom glass assign the **U-factor Surface** tag to “None”.
 - **Interior Glazing System:** for the first 63.5 mm of the top glazing system set the **U-factor Surface** tag to “Edge”, and the remainder of the glazing system to “None”. For the entire bottom glass assign the **U-factor Surface** tag to “None”.
 - **Exterior Frame:**
 - from the midpoint to the top sightline assign the **U-factor Surface** tag to “SHGC Exterior”
 - from midpoint to the bottom sightline assign the **U-factor Surface** tag to “None”.
 - **Exterior Glazing System:** set the **U-factor Surface** to “None”.

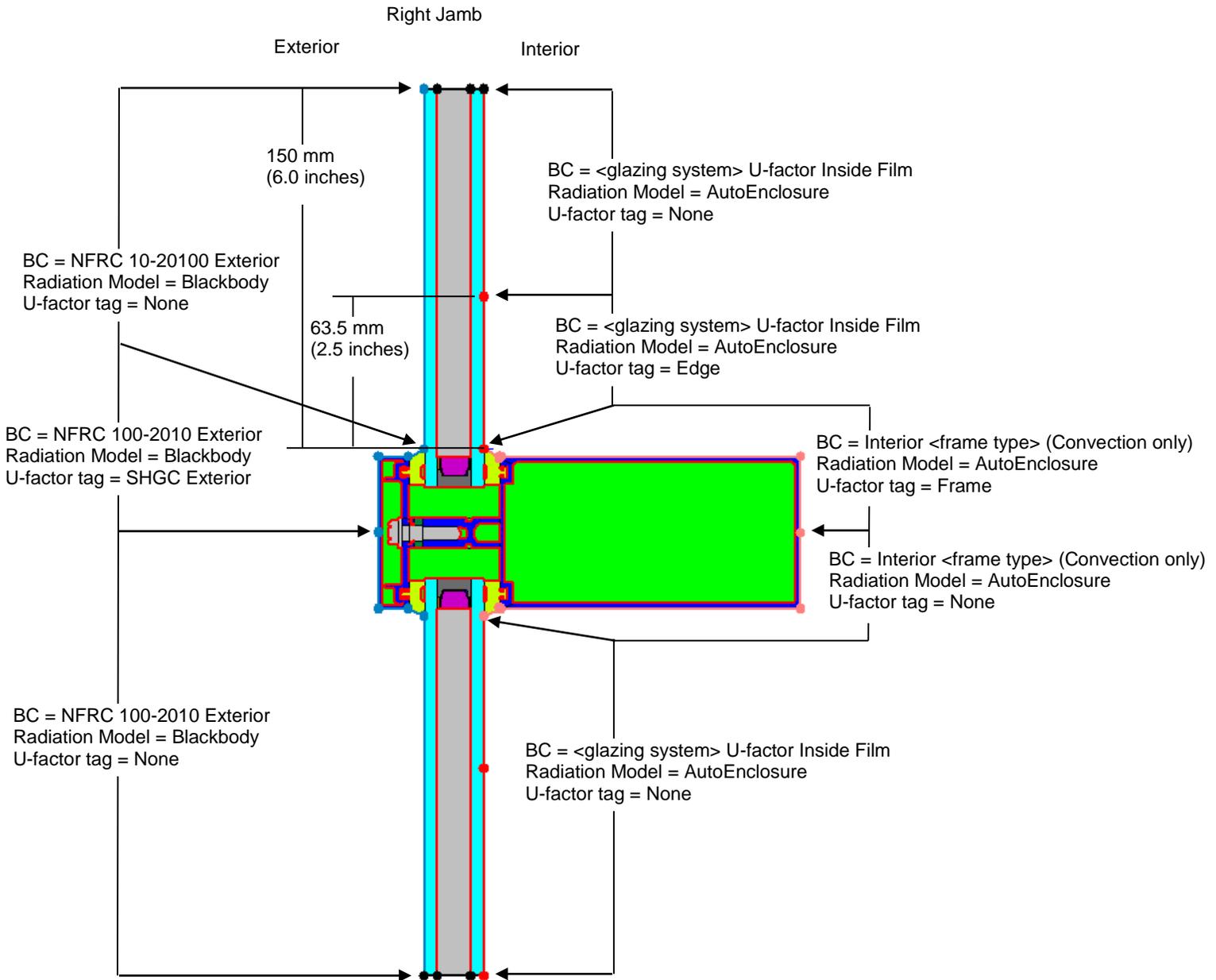


Figure 1-9. Right Jamb Boundary conditions

For the Left Jamb:

- The process is the same as the right jamb except that the Frame, edge and SHGC Exterior tags are assigned to the bottom half of the drawing and the top half is assigned the tag of "none"

Left Jamb

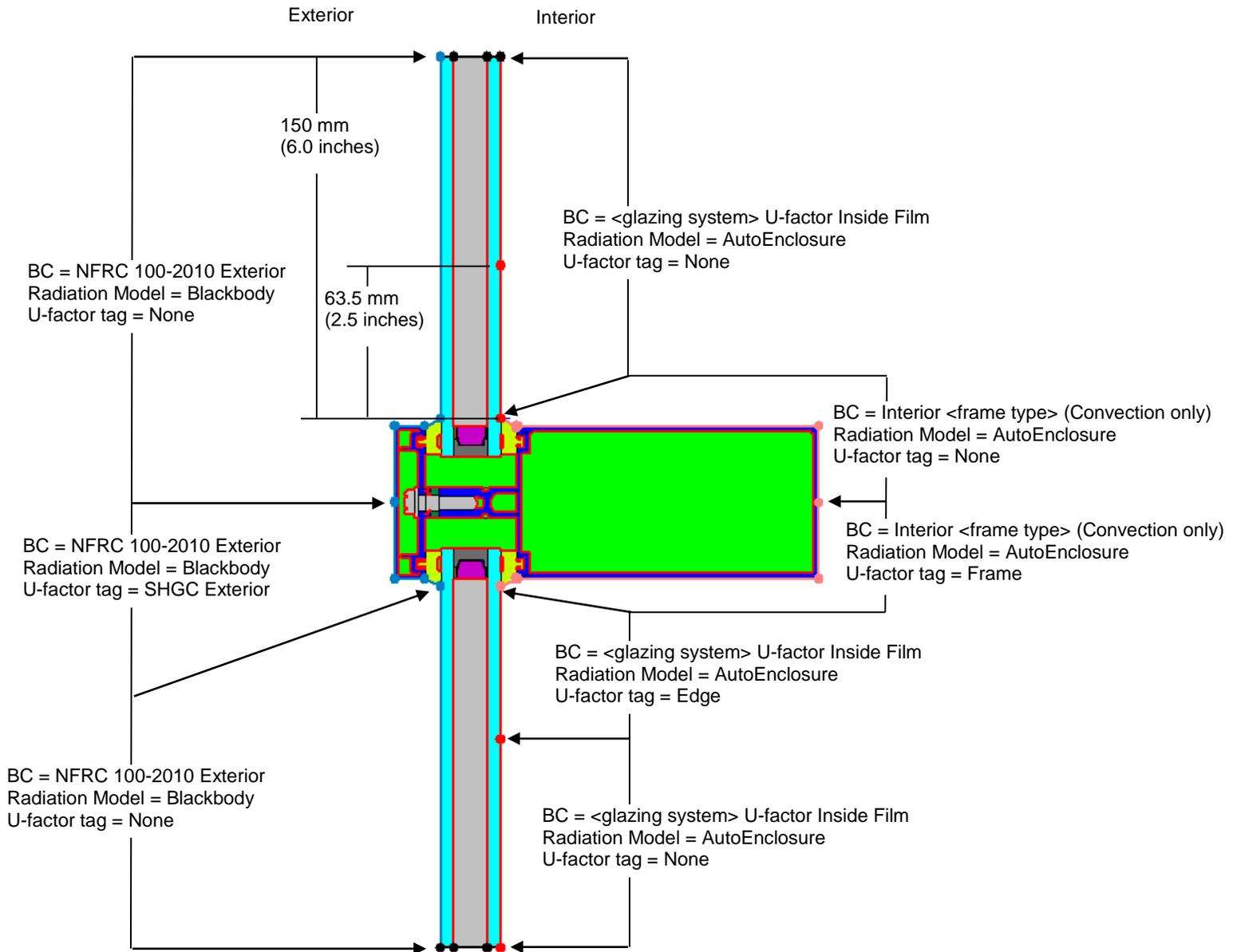


Figure 1-10. Left Jamb Boundary Conditions

NOTE: the THERM File option "Use CR Model for Window Glazing System" may be left checked since THERM will not calculate Condensation resistance for a cross section Type tagged Vertical Meeting Rail or Jamb.

Modeling the Intermediate Horizontal (as Head and Sill):

The horizontal frame cross section is drawn in exactly the same way as the intermediate vertical frame cross section, including inserting the midpoint. For this example the horizontal and vertical frames are identical so the same drawing is used. Assign boundary conditions in the usual way and then assign new boundary condition U-Factor Surface tags as follows for the head and sill.

For the Head:

- Use the drawing for the intermediate horizontal.
- In **Therm File Properties** (File/Properties), set the **Cross Section Type** to “Head”.
- Assign the Boundary Conditions as follows:
 - **Interior Frame:**
 - For the interior frame from the midpoint to the *bottom* sightline, set the **Boundary Condition** to “<frame type> Interior (Convection Only), and the **U-factor Surface** tag to “Frame”.
 - For the interior frame from midpoint to the *top* sightline, set the **Boundary Condition** to “<frame type> Interior (Convection Only), and the **U-factor Surface** tag to “None”.
 - **Interior Glazing:** Set the **Boundary Conditions** for each glazing system of the bottom of the glass to “<glazing system> U-factor Inside Film” and the **U-factor Surface** tag to “Edge” for the first 63.5 mm (2.5 inches) from the sightline, and “None” for the remainder of the glazing system.
 - **Exterior Frame:**
 - For the exterior frame from the midpoint to the *bottom* sightline, set the **BoundaryCondition** to “NFRC 100-2010 Exterior” and the **U-factor Surface** tag to “SHGC Exterior”.
 - For the exterior frame from the midpoint to the *top* sightline, set the **BoundaryCondition** to “NFRC 100-2010 Exterior” and the **U-factor Surface** tag to “None”.
 - **Exterior Glazing:** Set the **BoundaryCondition** to “NFRC 100-2010 Exterior” and the **U-factor Surface** tag to “None” for both exterior glazing systems.

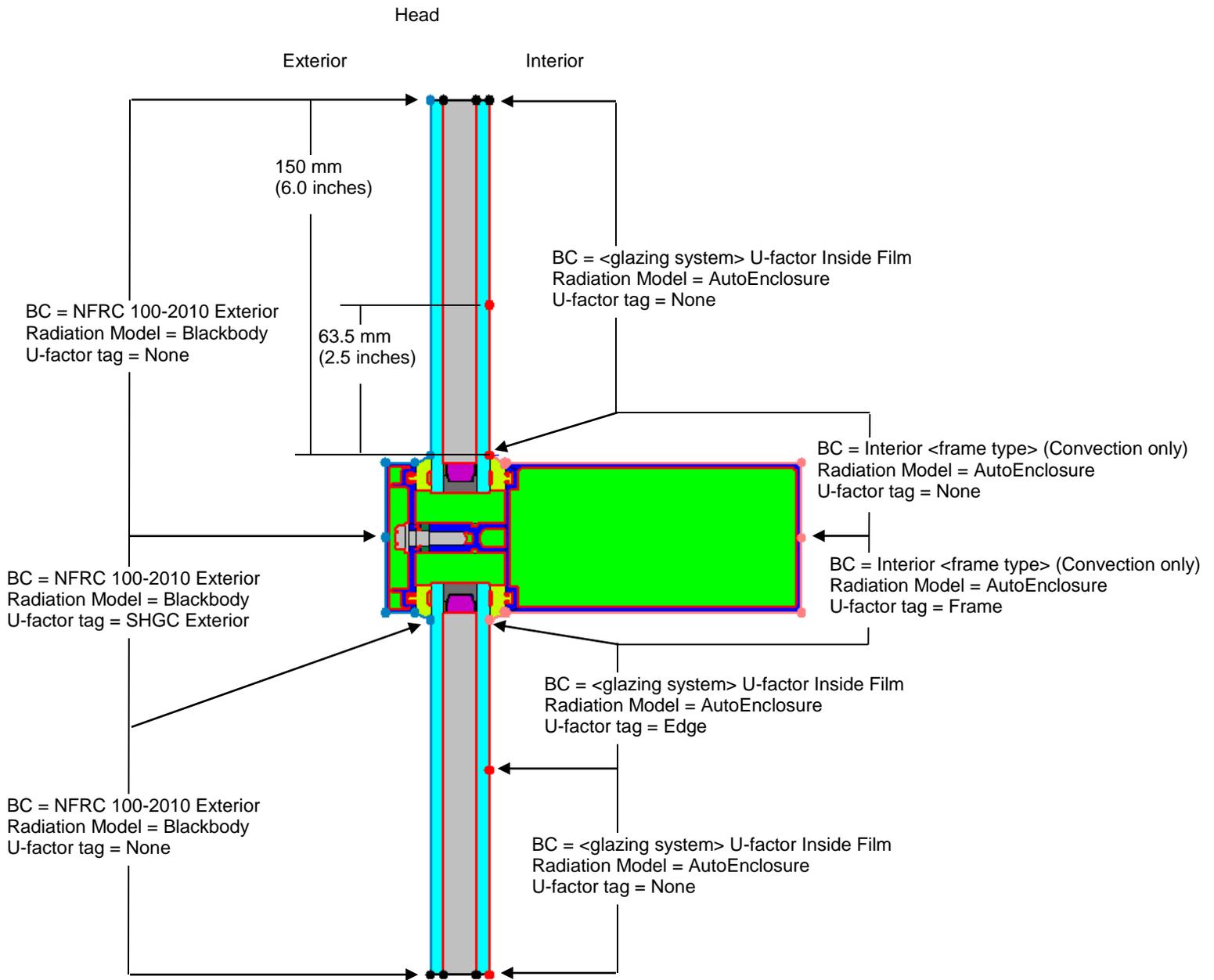


Figure 1-11. Head Boundary Conditions

For the Sill:

- Use the drawing for the intermediate horizontal.
- In **Therm File Properties** (File/Properties), set the **Cross Section Type** to “Sill”.
- Assign the Boundary Conditions as follows:
 - **Interior Frame:**
 - For the interior frame from the midpoint to the *top* sightline, set the **Boundary Condition** to “<frame type> Interior (Convection Only), and the **U-factor Surface** tag to “Frame”.
 - For the interior frame from midpoint to the *bottom* sightline, set the **Boundary Condition** to “<frame type> Interior (Convection Only), and the **U-factor Surface** tag to “None”.
 - **Interior Glazing:** Set the **Boundary Conditions** for each glazing system of the *top* of the glass to “<glazing system> U-factor Inside Film” and the **U-factor Surface** tag to “Edge” for the first 63.5 mm (2.5 inches) from the sightline, and “None” for the remainder of the glazing system.
 - **Exterior Frame:**
 - For the exterior frame from the midpoint to the *top* sightline, set the **BoundaryCondition** to “NFRC 100-2010 Exterior” and the **U-factor Surface** tag to “SHGC Exterior”.
 - For the exterior frame from the midpoint to the *bottom* sightline, set the **BoundaryCondition** to “NFRC 100-2010 Exterior” and the **U-factor Surface** tag to “None”.
 - **Exterior Glazing:** Set the **BoundaryCondition** to “NFRC 100-2010 Exterior” and the **U-factor Surface** tag to “None” for both exterior glazing systems.

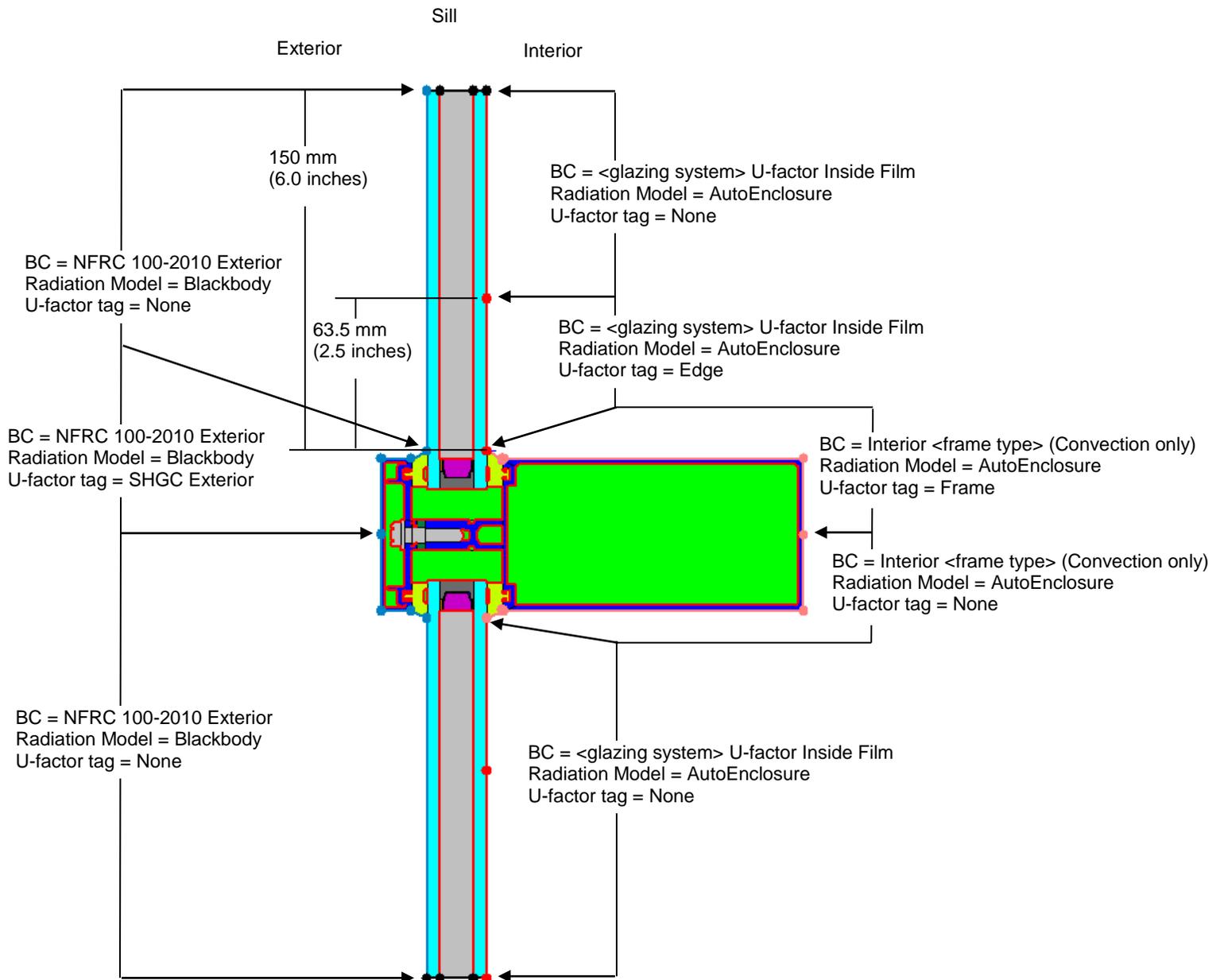


Figure 1-12. Sill Boundary conditions

It is a good idea at this point to verify the orientation and the direction of the gravity arrows of these sections.

In WINDOW:

Calculate these files and import into WINDOW. Use the files to create the whole product in the Window Library as applicable.